TESTING OF SANITARY SEWERS, WATERLINES AND FORCEMAINS

ITEM 1600

WORK INCLUDED: (Sec. 01) Furnish all labor, material, equipment, water, air and services required to perform the tests as described herein.

The Contractor shall make a complete record of tests to be attested by the Resident Representative.

DESCRIPTION: (Sec. 02) Tests shall be performed for the various services as follows:

Section 1600.04	Testing of Sanitary Service Sewers and Storm Drain.
Section 1600.05	Testing of Waterlines, Force Mains and Process Piping.
Section 1600.06	Testing of Air, Fuel Gas and Plant Gas Lines.
Section 1600.07	Testing of Plumbing System.

PROCEDURE: (Sec. 03) The testing equipment shall be approved by the Resident Representative.

The Resident Representative will witness the tests and approve the pipe installation. This approval, however, does not relieve the Contractor of his responsibility for a tight and satisfactory installation if leaks are found or develop subsequently.

Test service lines in accordance with the procedures specified in the applicable sections for the type of test being performed.

Repair or replace any portion of the lines which does not meet the required test, and retest by the same method used in the original test until requirements are met.

Protect gauges or delicate instruments installed in the lines against damage or excess pressure during the test.

Asbestos-cement pipe shall have a retention period of 12 to 24 hours after being filled as specified in the Items for Asbestos-Cement Pipe Gravity Sewers or Pressure Pipe.

Testing of portions of the installed pipe line or sewer may be waived by the Owner if in his judgment the testing is not essential.

TESTING OF SANITARY SEWERS AND STORM DRAINS: (Sec. 04) No well points nor pumps which would have an effect on the ground water measurement shall be operating at the time of the test.

Ground Water Pressure: Before initiating an infiltration, exfiltration or low pressure air test, determine the ground water pressure at the low end of the section to be tested. Provide a one-half inch capped nipple in the manhole at the top of the lowest pipe entering the manhole, for this purpose. Remove the cap and use an air jet to blow the mud and debris out of the nipple and provide a cavity for the ground water to enter. Attach a transparent plastic tube to the nipple and

extend vertically in the manhole. Measure the water level in the tube in feet, from the invert of the pipe being tested. This figure divided by 2.3 will give the pounds per square inch of external pressure on the pipe due to the ground water. After the ground water pressure has been determined and recorded on the test report, remove the plastic tube and replace the cap.

Type of Test: If the water in the plastic tube is observed to be at a level above the high point of the section being tested, an infiltration test shall be performed.

If the level in the tube is lower than the high point of the section being tested, an exfiltration test shall be performed.

A low pressure air test may be performed in lieu of an infiltration or exfiltration test.

Infiltration Test: Test the sanitary or combined sewer system as the line is being installed. Install no more than four manhole to manhole reaches not to exceed 1200 lineal feet of pipe, whichever is less, before testing is performed. The Contractor shall conduct a test for lengths less than four reaches if requested. Perform this test after the branch and service sewers installed under the contract have been completed and the ends securely plugged.

the permissible leakage for sewers tested by infiltration shall not exceed 100gal/day/inch of pipe diameter/mile of pipe.

Furnish and install a 90 degree sharp crested V notched weir at the lower end of the section of the line to be tested. The weir shall be installed properly, securely, with edges sealed watertight. The resident Representative shall approve the installation.

After the Contractor and Resident Representative have concurred that a maximum flow is being maintained through the weir, read the height of the flow above the crest of the weir by means of a hook gauge. The point of measurement shall be upstream from the weir a distance o 18 inches or three times the height of flow over the weir, whichever is greater.

The infiltration flow indicated by the height of the flow above the crest of a 90 degree weir is as follows:

flow level above crest of weir	gal. per day
¼”	99
½”	604
¾”	1585
1”	3165
1-1/4”	5520
1-1/2”	8720
1-3/4”	12800
2”	17850

Determine the allowable infiltration rate as follows:

$1 = \frac{100 \times LD}{5280}$ (for sewers)

$1 = \frac{1000 \times LD}{5280}$ (for storm drains

1 – Allowable infiltration
L – Length of pipe in feet
D – Diameter of pipe in inches

If the measured flow exceeds the allowable flow, make the necessary repairs and retest until the infiltration rate is less that the allowable rate.

If the ground water level is above any of the service sewers, add the LD of the service sewers to the LD of the main sewers.

As an alternative to the weir method, the Contractor may use a plug with a two inch pipe attached thereto in the lower end of the section being tested. Collect the pipe discharge into a container of known volume, measure the flow accordingly and compare with the allowable infiltration rate.

Storm drains shall be tested if requested by the Owner or Resident Representative based on his judgment of the workmanship and laying conditions. If required, perform an infiltration test for storm drains in the same manner as specified above except that the allowable infiltration rate shall be 1000 gallons per day (24 hours) per mile of pipe, per inch of pipe diameter.

Exfiltration Test: Test the sanitary or combined sewer system by the exfiltration method for each reach of pipe between manholes after the service sewers attached thereto have been installed.

The permissible leakage for sewers tested as described in this section shall not exceed 100 gal/day/inch of pipe diameter/mile of pipe.

Plug all openings in the upstream manhole except opening to sewer being tested and plug downstream end of sewer being tested. Fill sewer and upstream manhole to a level three feet above top of the sewer or three feet above groundwater level whichever is higher and let stand for three hours to allow for absorption. Refill to original level. After two hours check drop in water level in upper manhole and calculate the loss in volume. Convert the exfiltration measured to a 24 hour basis and compare with allowable leakage as determined similar to the infiltration rate per formula above.

If required, perform an exfiltration test for storm drains in the same manner as specified above except that the allowable exfiltration rate shall be 1000 gallons per day (24 hours) per inch of pipe diameter per mile of pipe and the absorption test will not be required.

Low Pressure Air Test: After completing the backfill of a reach of service main with its connected service sewers, the Contractor shall conduct a low pressure air test using suitable equipment, preferably pneumatic plugs and a single control panel with approved gauges.

Before proceeding with the test, seal test the pneumatic plugs by inserting one in each end of a length of pipe and inflating to 25 psig. Pressurize the sealed pipe to five psig. The plugs shall hold against this pressure without bracing and without movement of the plugs.

If the plugs check out satisfactorily, insert a plug in each end of the main sewer at the manhole. Close the ends of the service sewers at the property line with pneumatic plugs or other suitable means. Brace plugs if necessary to insure against blowing out.

Provide a pressure relief valve at the compressor set at ten pounds to protect the sewers from excessive pressure.

Introduce low pressure air into the sealed sewer at the high end until the pressure registers four psig more than the ground water pressure. Hold this pressure in the sewer for at least two minutes to allow the air pressure to stabilize. After the stabilization period, set the pressure in the sewers at 3.5 psig more than the ground water pressure and shut off the air supply. The portion of the sewer being tested will be termed "acceptable" if the time required for the pressure to drop one pound is greater than the time shown in the following Table.

MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

				Specification Time for Length(L) Shown(min:sec)							
1 Pipe Diam-eter (in.)	2 Minimum Time (min: sec)	3 Length for Minimum Time (ft.)	4 Time Longer Length (sec.)	100ft.	150ft.	200ft.	250ft.	300ft	350ft.	400ft.	450ft.
4	3:46	597	.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:51	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306L	28.51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25:852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

Chemical Grout: Leaks in sewers may be plugged by chemical grout provided the materials and methods to be used are approved by the Owner and the Engineer prior to start of repair work.

Deflection Testing: In addition to the leakage test, after 30 days the contractor shall furnish all labor, materials and equipment and perform a deflection test using a mandrel whose diameter is equal to 95% of the inside diameter of the pipe, manually pulled through the

sewer line.

The mandrel shall have a minimum of eight legs, and shall test for inside diameter dimension 95% of those stated in ASTM D-3034.

Deflection tests shall be made on all section of sewer.

Deflection of the pipe shall not exceed 5%.

Any section of pipe not meeting the deflection test shall be uncovered and "re-rounded" by re-compacting the bedding material, or by other means as required, or as directed by the Resident Representative, and the pipe retested until it meets requirements.

Owner Inspection: The owner reserves the right to check the installation for alignment, grade and tightness by means of photography, television or other appropriate methods. Any portion of the sewer not conforming to the specifications for these requirements shall be repaired at the Contractor's expense. The inspection will be at the Owner's expense.

TESTING OF WATER LINES, FORCE MAINS AND PROCESS PIPING: (Sec. 05)

Description: Apply a hydrostatic pressure test and a leakage test to all force mains, water mains and process piping as specified herein and in accordance with AWWA C600.

Pressure Test: After the pipe has been installed and partially backfilled (if applicable) subject all newly installed pipe, or any valved section of it, unless otherwise specified, to a hydrostatic pressure test equal to 1-1/2 times the line working pressure (50% over the working pressure) but not less than 5.0 psig. The duration of each pressure test shall be at least 60 minutes.

Slowly fill each valved section of pipe with water to the specified test pressure, measured at the point of lowest elevation, by means of a pump connected to the pipe in a satisfactory manner.

Before applying the full test pressure, expel all air from the pipe. To accomplish this, make taps, if necessary, at the point of the highest elevation, and afterward tightly plug. Corporation cocks may be used.

Carefully examine all exposed pipes, glands, fittings, valves, hydrants, joints, etc., during the pressure test. Where the joints are made with joint compound, re-caulk all such joints showing visible leaks until tight. Remove and replace all cracked or defective pipe, glands, fittings, valves, or hydrants discovered under this pressure test, and repeat the test until the installation is satisfactory to the Resident Representative.

Leakage Test for Underground Lines: A leakage test shall be conducted after the pressure test has been satisfactorily completed. The Contractor shall furnish all required apparatus

as specified above. Test at 50 pounds per square inch. Run the leakage test for a period of two hours. Measure the amount of water required to maintain the working pressure at 30 minute intervals during the test.

Leakage is defined as the quantity of water that must be supplied into the newly installed pipe line, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

No installation using mechanical, push-on, bell and spigot or flanged joints will be accepted if the leakage is greater than L as determined by the formula:

$$L = \frac{ND \quad P}{3700}$$

L = the allowable leakage in gallons per hour
N = the number of joints in the length of line being tested
D = diameter of pipe, in inches
P = the average test pressure in pounds per square inch gauge

Method of Payment Payment to be included in the price of the various pipe, no separate payment will be made.